

JPRS 69497

27 July 1977

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
GEOPHYSICS, ASTRONOMY AND SPACE  
No. 402

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<b>BIBLIOGRAPHIC DATA SHEET</b>	1. Report No. <b>JPRS 69497</b>	2.	3. Recipient's Accession No.
4. Title and Subtitle <b>USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS - GEOPHYSICS, ASTRONOMY AND SPACE, No. 402</b>		5. Report Date <b>27 July 1977</b>	
7. Author(s)		6.	
9. Performing Organization Name and Address <b>Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201</b>		8. Performing Organization Rept. No.	
		10. Project/Task/Work Unit No.	
		11. Contract/Grant No.	
12. Sponsoring Organization Name and Address  <b>As above</b>		13. Type of Report & Period Covered	
		14.	
15. Supplementary Notes			
16. Abstracts  The report contains abstracts and news items on meteorology, oceanography, upper atmosphere and space research, astronomy and terrestrial physics, covering both science news and formal scientific reports. Published details of Soviet space spectacles are included.			
17. Key Words and Document Analysis. 17a. Descriptors  USSR Geophysics Astronomy Astronautics Meteorology Oceanography			
17b. Identifiers/Open-Ended Terms			
17c. COSATI Field/Group 3, 4A, 4B, 8, 22			
18. Availability Statement <b>Unlimited Availability Sold by NTIS Springfield, Virginia 22151</b>		19. Security Class (This Report) <b>UNCLASSIFIED</b>	21. No. of Pages <b>34</b>
		20. Security Class (This Page) <b>UNCLASSIFIED</b>	22. Price <b>PCAO3</b>

27 July 1977

# USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

## GEOPHYSICS, ASTRONOMY AND SPACE

No. 402

This serial publication contains abstracts of articles from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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## I. ASTRONOMY

### News

#### SOLAR EXPLOSION RECORDED AT USSURIYSK STATION

Moscow IZVESTIYA in Russian 25 Jun 77 p 6

[Article by A. Pushkar': Untitled]

[Text] Vladivostok. Astronomers at the Ussuriysk station of the Sun Service have recorded a solar explosion. The exploding prominence was arc shaped.. It rapidly grew and then broke away from the solar surface, scattering into bright bursts. [5]

#### MAGNETIC PROPERTIES OF LUNAR ROCK

Riga SOVETSKAYA LATVIYA in Russian 1 Mar 77 p 2

[TASS Report: "Moon's Magnetic 'Chronicle'"]

[Text] Leningrad scientists who have studied the magnetic properties of lunar rock have read new pages in the "biography" of the moon.

They show that our planet's satellite was formed as an independent celestial body approximately two billion years ago and had its own magnetic field which was 25 times weaker than that of the earth. The presence of an internal nucleus near the moon at that time testifies to this.

Scientists from the Leningrad Division of the USSR Academy of Sciences' Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation have studied the moon's magnetic "chronicle" from samples obtained from the "Luna-16" and "Luna-20" Soviet automatic stations.

Now, as is known, the earth's moon does not have a magnetic field. By using precise equipment scientists have succeeded in observing and measuring the remanent magnetism in lunar rock. This magnetism is a unique "magnetic memory" of the past.

Conclusions and calculations of magnetologists are important for solving problems of the origin and development of the moon and also other celestial bodies. [5]



### Abstracts of Scientific Articles

#### EFFECT OF PHOTOSPHERIC MAGNETIC FIELDS ON SOLAR FLARE PROTONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 4, 1977 pp 798-801

[Article by N. A. Mikirova and N. K. Pereyaslova, Institute of Applied Geophysics, "Influence of Photospheric Magnetic Fields on Peculiarities of Propagation of Solar Flare Protons"]

[Abstract] This paper gives the results of a comparison of observations of solar protons with energies from 5 to 40 MeV registered in the high-latitude zones of the earth's magnetosphere at altitudes 700-1,000 km and magnetic fields on the sun. From published data on photospheric magnetic fields it was possible to analyze twelve events during the period from 1972 through 1976. In all considered cases of an increase in the intensity of solar cosmic rays it was possible to investigate the characteristics of proton penetration into the earth's magnetosphere; this made it possible to compute the anisotropy of the angular distribution of solar cosmic rays. A detailed study was made of the events of 3-6 July 1974 and 20 November 1975. It was found that the propagation of solar protons from a flare to the base of the sun-earth line of force is limited by the neutral lines of the longitudinal magnetic field. If the longitude of joining and the flare are in different unipolar magnetic regions, registry of particles at the earth is observed after intersection of the longitude of joining with eastward movement of the neutral line separating these regions. The rate of decay of the intensity of solar cosmic rays after the maximum is determined by the difference  $\Delta t$  between the time of the flare, if the flare and the longitude of joining are situated in a single unipolar magnetic region, and the time of intersection of the line of joining of the next neutral line of force. In describing the decay rate of solar cosmic rays by an exponential law, the decay constant  $T_0$  varies from 4-6 hours for  $\Delta t = 15-24$  hours to  $T_0 = 15$  hours with an increase in  $\Delta t$  up to 40 hours and can be approximated by the dependence

$$T_0 = 1.25e^{0.07\Delta t}.$$

Comparison of the decay rate in events in which solar cosmic rays were propagated between the boundaries of the sectoral structure and shock waves with the maximum value of anisotropy of the angular distribution of protons revealed a correlation dependence:  $1/T_0 = -0.007 + 0.004A_{\max}$ .

[104]

## NUCLEAR ENERGY SOURCES IN JUPITER

Moscow PRIRODA in Russian No 5, 1977 p 12

[Article by L. I. Miroshnichenko, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Nuclear Energy Sources in Jupiter?"]

[Abstract] Jupiter is usually regarded as a planet, but it might be a star. A. A. Suchkov of Rostov State University has postulated that the luminosity of Jupiter can be maintained by the reaction of deuterium combustion. One of the arguments in favor of the hypothesis of the presence of internal energy sources in Jupiter is the fact that it emits more energy than it receives from the sun. The hypothesis of the existence of nuclear reactions in Jupiter makes it possible to consider an alternative approach to this problem: It can be shown that the deuterium combustion reaction, transpiring only in a hundredth of the mass of Jupiter, is capable of ensuring the observed luminosity. On the basis of his computations, Suchkov (ASTRONOMICHESKIY ZHURNAL, Vol 53, No 1, p 217, 1976) has concluded that Jupiter can be a slowly "ageing" star which is in the stage of burning-out of deuterium. According to the theory of R. B. Salimzibarov of the Institute of Space Physics Research and Aeronomy of the Yakutsk Affiliate of the Siberian Department USSR Academy of Sciences, Jupiter is a star situated in the stage of formation with subsequent formation of the Jupiter star - sun system. The author feels that the source of matter for evening-out the masses of Jupiter and the sun is the gas and dust particles present in the transition region between the solar wind and the interstellar medium. If it is assumed that the mass of the sun is invariable, the temperature of the neutral gas is  $10^2\text{K}$  and its density is about  $1\text{ atom/cm}^3$ , the mass of Jupiter will be comparable to the solar mass after three billion years.

[116]

## II. METEOROLOGY

### News

#### NOTES ON ANTIHAIL WORK IN THE USSR

Moscow IZVESTIYA in Russian 2 Jun 77 p 6

[Article by A. Plutnik, "Through Clouds Out of a Cannon"]

[Summary] At times a real cannonading can be heard in the neighborhood of Nal'chik. The specialized service for contending with hail in the Northern Caucasus is working hard. From approximately mid-May through the end of June the agricultural crops face the greatest danger from hail. The scientific direction of this work is by the High-Mountain Geophysical Institute of the Main Administration of the Hydrometeorological Service. The deputy director of the institute is Nodairi Shalovich Bibilashvili. He stated that each year more than a billion rubles damage is inflicted by hail. In the USSR work in this field began in the late 1950's; the initiator was Ye. K. Fedorov. Scientists at Moscow, Kiev, Nal'chik and Tbilisi formulated a model of a hail cloud. A power equal to that of several major electric power stations is expended on the formation of such a hail cloud. That is why a direct attack on it is impossible. Scientists had to find a weak link in the process. They developed methods for stimulating physical processes in clouds which will prevent the generation and growth of hail. For this purpose crystallizing substances, such as silver iodide, are introduced directly into the clouds by means of special shells and rockets. It causes the appearance of a great number of artificial ice nuclei. As a result, instead of large hail, a vast number of small hailstones is formed. Falling through the warm layers of the atmosphere, they reach the earth's surface in the form of a fine rain. For recognizing hail-dangerous clouds there are special methods and radar apparatus. The radar is capable of detecting a zone of generation of hail and can be used in estimating the size of the falling hailstones. In the USSR the method developed at the institute is being employed for work in the Northern Caucasus, in Transcaucasia and in Central Asia. An area of about five million hectares of agricultural crops in the USSR is protected in this way.

[90]

### Abstracts of Scientific Articles

#### SPECTRUM OF PARTICLE SIZE OF $PbI_2$ REAGENT USED IN ANTIHAIL WORK

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 86, No 1, 1977 pp 85-88

[Article by K. A. Tavartkiladze, Geographical Institute Georgian Academy of Sciences, "Spectrum of Particles of  $PbI_2$  Reagent Used in Antihail Work"]

[Abstract] An attempt is made to determine (optically) the spectrum of particle size of a  $PbI_2$  reagent introduced into clouds using an explosive shell immediately after its detonation. For this purpose the author used the method of determining the spectrum of particles of a disperse system using data on its transparency. The method was used in determining the relative distribution of atmospheric aerosol particles by size along the solar rays. If the spectral transparency of the atmosphere is determined in the clear sky and if the aerosol spectrum is computed, and then the reagent is seeded between the sun and the detector of the measuring instrument and transparency is determined, and then the spectrum is ascertained, the difference between the second and first distribution determines the particle size spectrum of the introduced aerosols. The experiment was carried out on 30 October 1971, at midday, when the sky was completely clear, in the polygon of the Tetritskaroyskaya Antihail Expedition. Spectral atmospheric transparency was first measured in 13 parts of the spectrum from 0.36 to  $0.82\mu m$ . At the same time, total moisture content of the atmosphere was measured using a radiosonde. Then the aerosol optical thickness was computed using the total content of water vapor and ozone and elevation above sea level. After this the shell with the  $PbI_2$  reagent was shot by an artillery piece between the sun and the detector and at a distance of 2 km from the detector the reagent was scattered by a detonation in the atmosphere. After introducing the reagent there was an approximately uniform decrease in optical thickness in the entire spectral range. Formulas are given for determining the spectrum of aerosol particles. It was found that reagent particles with a size less than  $1\mu m$  have a discrete distribution with three maxima at about 0.3, 0.6 and  $0.9\mu m$ . The numbers of particles with sizes of about 0.3 and  $0.6\mu m$  are approximately equal, whereas particles with a size of about  $0.9\mu m$  are half as numerous as those in the 0.3 or  $0.6\mu m$  range.

[129]

## CHEMICAL COMPOSITION OF PRECIPITATION OVER PACIFIC

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 86, No 1, 1977 pp 145-148

[Article by G. D. Supatashvili, Tbilisi State University, "Chemical Composition of Precipitation Over the Central and Southern Parts of the Pacific Ocean"]

[Abstract] In 1973, during the ninth voyage of the scientific research vessel "Dmitriy Mendeleev" in the central and southern parts of the Pacific Ocean, specialists collected 16 samples of precipitation. The samples were collected on the upper deck while the vessel was moored. Precipitation over the Pacific Ocean has a slightly acidic reaction (pH 5.08-6.86, mean 5.93). The pH value correlates with the content of  $\text{HCO}_3^-$  and the sum of principal ions ( $\Sigma_{\text{ion}}$ ). The content of principal ions and their sum in precipitation over the ocean vary in a wide range. A table gives the dependence of the chemical composition of precipitation over the ocean on wind velocity; another gives the dependence of the content of principal ions on the intensity of precipitation. The content of the principal ions in this precipitation is inversely related to the intensity of falling of precipitation. With an increase in the intensity of precipitation there is also a decrease in the Cl/Na ratio. A study was made of the content of boron, bromine and iodine in Pacific Ocean precipitation. The mean contents of these elements were 25, 82 and 48  $\mu\text{g/liter}$ . The patterns of trace elements in precipitation and aerosols over the Pacific Ocean will be examined in a separate study. [129]

## VARIATIONS IN TOTAL OZONE IN EUROPEAN AREA

Budapest IDOJARAS in Hungarian No 2, 1977 pp 94-99

[Article by Borbely Edit, Hungarian State Meteorological Service, "Variations in the Trend of the Total Content of Ozone in the Atmosphere in Europe"]

[Abstract] The long-term variations of the total quantity of ozone and the direction of its trends were studied on the basis of data collected at six Central European stations during the period from 1964 to 1974. The results indicated a definitely positive (rising) trend for the stations Arosa, Oxford and Hradec Kralove, whereas a negative (dropping) trend was found for the stations Belsk and Potsdam. The highest of the three positive values is that of Oxford, being +2.15% for the 10-year period. The positive values of the stations Arosa and Hradec Kralove are much lower. The negative value for Potsdam exhibits an essential decrease, while that of Belsk is not too significant. The negative trend cannot be explained by meteorological elements since no similar increase appears at other Central European stations.

It can be assumed that the negative trend is due to measurement errors but this assumption cannot be proved with full certainty. In addition, the relationship between the total ozone content and the zonal wind, as well as with the quasi-two-year cycle is analyzed. Of the eleven years analyzed, three years (1966, 1970 and 1973) were found when the maxima and three years (1967, 1969 and 1972) when the minima occurred almost in the same months. The 26-month oscillation did not appear either in the wind data or in the ozone data. The extreme values occur unsystematically, that is, the cycles have different length. There are also very significant variations in the amplitudes in the different series.  
[121]

#### WEATHER RADAR OBSERVATIONS IN HUNGARY

Budapest IDOJARAS in Hungarian No 2, 1977 pp 107-118

[Article by Kapovits Albert, Meteorological Institute, Budapest, "Organization of Weather Radar Observations in Hungary and the Experiences Obtained as a Result of Observations"]

[Abstract] The BWR-X12 weather radar operating in Budapest is described on the basis of theoretical computations of its possibilities and the experience of more than 20,000 hours operating time. The author describes radar meteorological observations, the data transmission system and the field of applicability of radar meteorology. The importance of radar observations for broadening meteorological knowledge is demonstrated by means of brief statistical investigations.  
[121]

### III. OCEANOGRAPHY

#### News

#### SOVIET OCEANOGRAPHIC CONGRESS IN MOSCOW

Moscow IZVESTIYA in Russian 21 Jun 77 p 5

[TASS Report, "Congress of Soviet Oceanographers"]

[Text] The First Congress of Soviet Oceanographers opened in Moscow on 20 June. More than 2,000 scientists and specialists are participating in it. Many of these people have travelled more than 1,000 nautical miles on scientific research expeditionary vessels. They have gathered here to examine work being done in the five-year plan's study of the world ocean and use of its resources. They will also evaluate the courses of forthcoming investigations.

Academician L. M. Brekhovskikh presented a paper on the tasks of Soviet oceanographers in light of the decisions of the 25th Congress CPSU. He noted that the study of the ocean is proceeding at a fast pace in the Soviet Union. Soviet scientists occupy foremost positions in the area of scientific studies and practical work in this vitally important branch of the national economy. [5]

#### ESTONIAN SCIENTISTS CREATE MODEL OF BALTIC SEA

Riga SOVETSKAYA LATVIYA in Russian 1 March 77 p 1

[TASS Report, "Model of the Baltic Seas Has Been Created"]

[Text] Scientists of the Estonian Academy of Sciences have constructed a model of the Baltic Sea. This model consists of a series of mathematical equations which generalize the results of studies of many years.

The present level of the development of mathematics has made it possible to represent the special features of the relief structure of the sea floor, internal currents and water temperature and salinity distribution in the form of formulas. Now scientists, who have the reference characteristics of any part of the sea, can arrange them in the model and check them on a computer. The data obtained will be of use in studies of the underwater world. [5]

#### ADDRESS OF USSR COUNCIL OF MINISTERS TO CONGRESS OF OCEANOGRAPHERS

Moscow IZVESTIYA in Russian 21 Jun 77 p 2

[Address of USSR Council of Ministers: "To the Participants of the First Congress of Soviet Oceanographers"]

[Excerpt] The USSR government greets the participants of the First Congress of Soviet Oceanographers. Soviet marine science began with a decree signed by V. I. Lenin in 1921 which called for the study of the seas of the North Arctic. Since that time the Soviet government has consistently given much attention to world ocean research. In our country a number of oceanological institutes have been created and Soviet research ships are conducting studies in the seas and oceans.

It is difficult to overestimate the significance of the seas and oceans for the country's economy as sources of food, mineral and energy resources. Therefore, Soviet oceanographers must concentrate on thoroughly studying and rationally using the world ocean and its resources. Profound fundamental research and the development of theoretical foundations of modern oceanography are necessary for the successful solution of the tasks aimed at developing marine resources. [5]

#### COMMENTS ON CONGRESS OF SOVIET OCEANOLOGISTS

Moscow IZVESTIYA in Russian 19 Jun 77 p 6

[Unsigned article, "The Ocean is Full of Riddles"]

[Text] The First Congress of Soviet Oceanologists opened in Moscow on 20 June. At the request of an IZVESTIYA correspondent A. Ivakhnov, Academician L. Brekhovskikh, Academician-Secretary of the Division of Oceanology, Atmospheric Physics and Geography USSR Academy of Sciences, tells about the tasks of this major scientific forum and the matters which will be discussed there.



-- Leonid Maksimovich, evidently it is no accident that the need has now arisen for the representatives of the most different sciences dealing with the ocean to gather around the round table. It must be assumed that the discussions at the congress will center on the joining of their efforts, the formulation of a unified work program.

-- In actuality, we already have such a program. This is the five-year plan for investigating the ocean and exploiting its resources which was developed by the USSR Academy of Sciences in collaboration with other interested departments and approved by the State Committee of the USSR Council of Ministers on Science and Technology. The discussions at the congress will be on how this plan is being implemented.

Oceanology is developing very rapidly and the need for investigating the ocean is continuously increasing. And although we very frequently meet in different individual fields of specialization, our oceanographic commission organizes an average of about ten conferences each year on different fields of the science, naturally the time is long past when there has been a need for all of us to meet together.

Oceanology cannot be regarded as simply the sum of different sciences; it is impossible to say, for example, that geologists should be concerned exclusively with the bottom, physicists with the dynamics of waters, and that biologists, aside from all else, should study life in the depths of the sea. In actuality, all these are very closely related to one another. For example, in order for geologists to be able to understand correctly the origin of the sedimentary bottom layer, they must know what currents existed in the ocean in the past -- and at different times the currents were quite different from now. And here we cannot get by without the results obtained by physicists. Geologists in turn are studying the sea floor. But it appears that the distribution of life in the ocean is dependent on bottom relief. And biologists therefore cannot move in their work without the information which can be given them by geomorphologists.

Scientists from branch scientific institutes have shown a great interest in our congress. Fishing, mineral production, sea transport, weather forecasting -- we could extend more and more the list of fields of human activity which make use of the results of oceanological research.

Participating in the congress are 113 organizations, of which 53 are from the national and republic Academies of Sciences, many institutes of the Hydrometeorological Service, Ministry of Geology, Fisheries Ministry and higher educational institutions.

-- In one of your recent articles you wrote that the ocean is a storehouse of many mysteries. At the congress there will obviously be a discussion of these mysteries. Could you not mention some of them?

-- During the time of the "Poligon-70" experiment in the tropical zone of the Atlantic Ocean our scientists discovered gigantic water vortices whose diameter attained hundreds of kilometers. The directions of rotation of the water around the centers of these vortices were different. In one direction the nucleus of the vortex was colder than the periphery; in the opposite direction -- warmer. In cases when the nucleus is colder, within the vortex there is an increased bioproductivity. We relate this to the upwelling of internal waters enriched with nutrients.

What is the source of the gigantic vortices? How do they interact with currents and with one another? What is their final fate? Scientists are only now beginning to answer these questions.

Another interesting mystery is internal waves in the ocean. If you see a completely quiet, smooth water surface, this does not mean at all that everything is calm in its internal layers. There can "rage" a real storm (and the word is put in quotes because the underwater waves develop far more slowly than the surface waves). Other underwater waves attain an amplitude of a hundred meters. How to visualize this? Let's say that the water surface now oscillates. The water surface is the boundary between the water and air, that is, two media with different density. But, indeed, in the depths of the ocean there are water layers with different density. It is now the boundary between two such layers. At rest it, like the water surface, is smooth. But what reason forces the heavy layer to rise, bulge in a hump? Then it goes downward and the disturbances are propagated in all directions -- the internal waves run... For the time being we know little about the sources of internal waves. Why do we want to know such things? Internal waves, for example, distort underwater acoustic oscillations, which is very important for those who are concerned with the question of underwater acoustic communication.

And is not the question of how ferromanganese nodules are formed of interest? In some regions of the world ocean these dark brown lumps literally cover the floor. Here is a photograph: it is as if you enter a room where a deck of cards has been scattered on the floor... How did these formations come to be? This is not a simple question. For the time being I have not heard any sound theory on this from a single geologist.

Specialists in the field of marine geology are sharing many secrets with us. Now, for example, they are formulating mathematical models of the biological community in the ocean. It appears that it is impossible to represent underwater life by studying different species of fish and marine animals separately. As we say, there are many trophic levels which differ from one another with respect to "who's who." Only by analyzing all this diversity and studying the relationships between the levels is it possible to give correct recommendations on the use of the biological resources of the ocean. And take bionics. How does a fish migrating in the ocean's depths orient itself? What is the structure of the surprisingly effective and at the same time very compact ranging apparatus of cetaceans? Are these not interesting problems?

Finally, the mystery of mysteries -- structure of the ocean floor. By studying it we can better understand the geological history of our planet, refine the patterns of formation of mineral resources -- both underwater and on the continents. During recent years Soviet and American scientists have carried out intensive work for drilling the ocean floor from aboard the scientific research ship "Glomar Challenger" -- first the sedimentary stratum and then the deeper layers. As a result of these investigations it was possible to formulate a new concept of the geological structure of the earth's crust. According to this concept, the earth's crust consists of some quantity of gigantic plates which support entire continents. These plates move together, move apart, slide one over the other, and as a result the continents are gnawed away and mountains are formed. The further work of marine geologists will reveal many new phenomena and details in this picture.

Thus, in oceanology there is an unbounded number of problems. When we find solutions to these, new mysteries will arise before us, possibly still more complex and in greater number...

[117]

### Abstracts of Scientific Articles

#### USE OF FINITE DIFFERENCES FOR DIFFERENTIATING TIDAL WAVES

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 86, No 1, 1977 pp 81-84

[Article by K. Z. Kartvelishvili, Geophysical Institute Georgian SSR, "Use of Finite Differences for Differentiating Some Tidal Waves"]

[Abstract] The expansion of the tide-generating potential into a series makes it possible to determine the periods for a large number of harmonics owing their origin to the tide-generating potentials of the moon and sun. Using the scheme for the expansion of the tide-generating potential which was developed by D. E. Cartwright and R. J. Taylor (GEOPHYS. J. ROY. SOC., 23, 1971) it is possible to determine the periods, theoretical amplitudes and phases of more than 500 tidal waves. The finite difference scheme elaborated here shows that the approach is particularly successful in discriminating waves whose periods differ appreciably from the periods of other waves. This is illustrated by examination of a continuous curve of 12 harmonics whose values were close to the theoretical values of the principal tidal waves. It was found to be easy to discriminate the harmonic with the parameters of the  $M_3$  wave from the complex curve. This is of great importance because up to now the  $M_3$  wave was discriminated from data for a very long series of observations (17 months or more). The proposed procedures make it possible to discriminate this harmonic with sufficient accuracy on the basis of data from a two-month series of observations.

[129]

#### IV. TERRESTRIAL GEOPHYSICS

##### News

##### UNDERGROUND TREMORS FELT IN DUSHANBE

Moscow IZVESTIYA in Russian 23 Jun 77 p 6

[Article by V. Surkov, "Roar From the Depths"]

[Text] On 22 June at 0020 hours LT the residents of the Tadzhik capital were awakened by underground tremors. The tremors shook building walls and caused them to crack.

According to preliminary data from the seismic station, the epicenter of the earthquake was located 10-15 kilometers from Dushanbe in the area of the Institute of Agriculture. In Dushanbe and at the epicenter the tremors registered force 4-5.

[5]

##### NEW MEMBERS ELECTED TO ACADEMY OF SCIENCES

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA GEOLOGICHESKAYA in Russian No 6, 1977 pp 140-142

[Article by A. F. Adamovich, Division of Geology, Geophysics and Geochemistry USSR Academy of Sciences, "General Meeting of the Division of Geology, Geophysics and Geochemistry USSR Academy of Sciences"]

[Abstract] A general meeting of the Division of Geology, Geophysics and Geochemistry USSR Academy of Sciences was held during the period 20-22 December 1976. Seven new Corresponding Members were elected. Yu. M. Pushcharovskiy is head of a laboratory at the Geological Institute and is a specialist in the field of regional geology and tectonics. He is the author of more than 120 scientific studies. He has worked on the classification of large structures in the earth's crust, its tectonic regionalization and

evolution. Yu. M. Pushcharovskiy is the author and editor of tectonic maps of Eurasia, the Pacific Ocean region of the earth, the Arctic, Cuba, the Caribbean region and some others. Ye. Ye. Milanovskiy is a department head at Moscow State University. He is a specialist in the field of regional geology, tectonics, neotectonics, rift-forming theory, volcanic geology and the geology of recent deposits. He has carried out a broad generalization of materials on orogenic volcanism and the neotectonics of the Mediterranean zone of Eurasia. He is a participant in the Complex East African Expedition and the Icelandic Geodynamic Expedition. He is the author of the monograph RIFTOVYYE ZONY KONTINENTOV (Rift Zones of the Continents). V. L. Barsukov is the director of the Institute of Geochemistry and Analytical Chemistry. The author of more than 80 scientific works, including three monographs, he has carried out investigations in the field of the geochemistry of ore-forming processes, geochemistry of magmatic rocks, geochemical prospecting methods, evaluation and prediction of mineralization. P. P. Timofeyev is a specialist in the field of coal geology and lithology and the author of more than 170 scientific studies, including six monographs. His investigations are devoted to the development of the genetic direction in coal geology and lithology. I. I. Nesterov is director of the West Siberian Scientific Research Geological Prospecting Institute of Petroleum. He is a specialist in the field of the geology of petroleum and gas. I. Ye. Gubin is a senior scientific specialist at the Institute of Physics of the Earth. He is a specialist in the field of seismotectonic and macroseismic investigations and the author of more than 60 scientific studies. He has established correspondence between geological and seismic phenomena and has demonstrated that destructive earthquakes do not always occur in seismic regions and not randomly, but in strict conformity to the peculiarities of tectonic movements and deformations of the earth's crust and upper mantle. A. V. Dokukin is the director of the Mining Institute, a mining engineer, specialist in the field of the technology and mechanization of underground working of deposits of solid minerals, rock destruction, dynamics and reliability of mining machinery and prediction of the development of the coal industry. He is the author of about 300 scientific studies. [Although vacancies existed for election of Academician, no one received the required number of votes.]

[126]

### Abstracts of Scientific Articles

#### SURFACE TILTS CAUSED BY ATMOSPHERIC PRESSURE CHANGES

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 85, No 3, 1977 pp 601-604

[Article by K. Z. Kartvelishvili and V. I. Mirianashvili, Geophysical Institute Georgian Academy of Sciences, "Observations of Tilts of the Earth's Surface Caused by Changes in Atmospheric Pressure"]

[Abstract] A study was made of tilts of the earth's surface caused by changes in atmospheric pressure using data obtained with photoelectric tiltmeters set up at the Laboratory of Tidal Deformations of the Earth Geophysical Institute Georgian Academy of Sciences and data published in weather bulletins of the Administration of the Hydrometeorological Service Georgian SSR. The collected data clearly indicated a correlation between the drift of tiltmeters and change in atmospheric pressure. It was also found that the deformations at a tiltmeter station occur earlier than the pressure at this station changes. Several specific examples are cited which show the definite relationship between tilts of nontidal origin and atmospheric pressure changes. The tabulated data published here characterize only the averaged influence of different meteorological factors on the drift of tiltmeters and make it possible to judge how great these influences are for different observation series.

[112]

#### STRONG EARTHQUAKES IN TURKMENIA IN 1973

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR, SERIYA FIZIKO-TEKHNICHESK-IKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 2, 1977 pp 51-58

[Article by G. L. Golinskiy, K. D. Lagutochkina and A. R. Rakhimov, Institute of Physics of the Earth and Atmosphere Turkmen Academy of Sciences, "Strong Earthquakes in Turkmenia in 1973"]

[Abstract] In 1973 the seismic network of Turkmenia registered 527 earthquakes. But due to the inadequate number of seismic stations the coordinates were determined for only 49.7% of the total number of earthquakes. The seismic activity of the region was characterized by a relatively quiet character: for the most part a process of accumulation of elastic stresses predominated. The relaxation of stresses occurred very nonuniformly: it was manifested more intensively in the middle part of the zone, in the territory of Iran and to a lesser degree within the limits of Turkmenia. In 1973 the coastal region of the Caspian Sea was less active in comparison with 1972.

[125]

#### COMPUTING STRESSES IN PLANETARY INTERIOR

Tbilisi SOOBASHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 86, No 1, 1977 pp 77-80

[Article by A. P. Trubitsyn, V. Sh. Meskhiya and V. N. Zharkov, Geophysical Institute Georgian Academy of Sciences and Institute of Physics of the Earth, USSR Academy of Sciences, "Computations of Stresses in the Interior of a Planet Using Data on its Gravitational Field"]

[Abstract] The difference between the observed gravity field of a planet and some field corresponding to hydrostatic equilibrium indicates the presence of excess masses creating nonhydrostatic stresses in the interior of a planet. If in the first approximation a planet is considered an elastic body, computation of these stresses is reduced to solution of the corresponding elastic equilibrium problem. This problem has been examined in earlier studies by the author (V. N. Zharkov, et al., FIZIKA ZEMLI I PLANET, Moscow, 1971; VVEDENIYE V FIZIKU LUNY, Moscow, 1969), where a study was made of cases of a homogeneous planet and a planet consisting of a solid shell and liquid core. In this article the methods described in the earlier papers are generalized for the case of a planet consisting of an arbitrary number of homogeneous layers. The described method is adequate for the study of relatively small planets of the earth group (moon, Mercury, Mars), when initial stresses need not be taken into account. For the Earth and Venus it is necessary to take great stresses into account and also solve the equations of the theory of elasticity jointly with the Poisson equation for the gravitational potential within the planet.

[129]



## GEOLOGICAL STRUCTURE OF UNDERWATER MARCUS RISE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 5, 1977 pp 1167-1170

[Article by I. K. Tuyezov, A. Ya. Il'yev, B. V. Alekseyev, G. D. Yerevin, V. I. Mikhaylov and M. Houston, Sakhalin Multidiscipline Scientific Research Institute and Far Eastern Scientific Center USSR Academy of Sciences, "Geological Structure of the Marcus Underwater Rise"]

[Abstract] Late in 1975 and early in 1976 specialists aboard the scientific research vessel "Pegas" carried out complex geophysical and geological investigations of the Marcus underwater rise, situated in the western part of the Marcus-Necker complex which extends from the southern tip of the Hawaiian archipelago to the zone of joining of the Idzu-Bonin and Marianas trenches. The ocean floor within the limits of the rise is uplifted above the the ocean floor in adjacent basins of the Pacific Ocean on the average by 300-400 m. Here there are many seamounts with an elevation from 1,000 to 4,000 m and with a depth of their peaks from 870 to 3,600 m. The conical form of the mounts and the volcanic nature of the rocks making them up indicate that for the most part these mountains are evidently underwater volcanoes. Most of these are guyots because their peaks as a rule are flat. According to data from deep seismic sounding, the velocities and thicknesses in the sedimentary and second layers are 1.96-2.15 and 3.60-6.00 km/sec, 800-1,600 and 3,000-5,000 m. The measured heat flow in the western part of the rise somewhat exceeds the mean world value and on the average is equal to  $1.34 \mu\text{cal/cm}^2/\text{sec}$ . The work included echo sounding, gravimetry, magnetometry, continuous seismic profiling and dredging. The most interesting data were obtained on the structure of the sedimentary stratified layer. Its thickness in the depressions between the underwater ridges attains 1,000-1,400 m, which is three or four times greater than its thickness in the basins of the Pacific Ocean adjacent to the Marcus Rise. The magnetic field in the Marcus Rise is quite sharply differentiated; its anomalies vary from -1,400 to +400  $\gamma$  with an average width of 20-40 km. The collected data on the geological structure of this rise indicate that it is not simply a clustering of volcanic structures, but an independent tectonic structure with its own history of development.

[118]

## ASTHENOSPHERIC ZONES IN THE SOVIET UNION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 234, No 4, 1977 pp 790-793

[Article by Corresponding Member USSR Academy of Sciences A. S. Alekseyev, L. L. Van'yan, M. N. Berdichevskiy, A. V. Nikolayev, B. A. Okulesskiy and V. Z. Ryaboy, "Map of Asthenospheric Zones in the Soviet Union"]

[Abstract] The results of analysis and generalization of velocity cross sections of the upper mantle constructed for different regions of the earth indicate that it is possible to discriminate two types of waveguides which differ with respect to their position in the cross section, thickness, velocity parameters and probably, the reasons for the decrease in velocity. Waveguides of the first type have a thickness not less than 50-100 km; their top is usually situated at a depth of more than 100 km. The thermodynamic conditions existing at these depths can lead to partial melting or amorphism of matter and these layers can be identified with the asthenosphere. The second type of waveguide includes layers of reduced velocity having a thickness up to 20-30 km and situated at depths not greater than 80-100 km. Judging from the geothermal data, the temperature of matter here should be below 1,100-1,200°; at such temperatures matter in general evidently is in a solid crystalline state and is not plastic. The upper mantle of platform regions is characterized in general by relatively high velocities; the waveguides here either are of a small thickness or are completely absent. Figure 1 in the text is a map of the distribution of a waveguide layer of the first type for the territory of the Soviet Union compiled on the basis of seismic data. The waveguide is well expressed in a number of tectonically active regions, but in some active regions there is no waveguide. It can be concluded that in most regions on the continents there is no conducting layer of the upper mantle with a conductivity exceeding  $10^4$  siemens. This conclusion is confirmed by an analysis of the most reliable experimental data, the results of which are shown on a map (Fig. 2) accompanying the text. The highest conductivity is observed in the Far Eastern transition zone, in the Baykal rift region, in the South Caspian megabasin, in the Northern Caucasus and in the Carpathian folded region. Comparison of Figures 1 and 2 shows a good agreement of seismic and geoelectric data. Relatively low mean velocity, small-scale velocity inhomogeneity, increased conductivity and plasticity -- all these are qualities of the asthenosphere widely developed in tectonically active regions; on the continents within the limits of the platforms and under ancient oceanic platforms there is predominantly regions of absence or poor development of asthenospheric zones in the upper mantle.

[104]

## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

#### LAUNCHING OF "MOLNIYA-1" COMMUNICATIONS SATELLITE

Moscow PRAVDA in Russian 25 Jun 77 p 2

[TASS Report: "'Molniya-1'"]

[Text] On 24 June 1977 a "Molniya-1" communications satellite was launched in the Soviet Union. The "Molniya-1" satellite is intended for operation in the system of long-range telephone and telegraph radio communication and also for transmission of USSR Central Television programs to points in the "Orbita" network located in regions of the Far North, Siberia, the Far East and Central Asia.

The satellite was inserted into a high elliptical orbit with the following parameters:

- apogee, 39,016 kilometers in the Northern Hemisphere;
- perigee, 480 kilometers in the Southern Hemisphere;
- period of revolution, 11 hours 40 minutes;
- orbital inclination, 62.9 degrees.

In addition to apparatus for transmission of television programs and for providing long-range multichannel radio communication, the satellite carries a command and measurement complex and also systems for orientation, orbital correction, and power supply for the satellite.

According to the collected data, the apparatus installed on board the satellite is functioning normally. Communications sessions using the "Molniya-1" satellite will be conducted in accordance with the planned program. [5]

#### TASS ANNOUNCES LAUNCHING OF "KOSMOS-921"

Moscow PRAVDA in Russian 25 Jun 77 p 2

[TASS Report, "'Kosmos-921'"]

[Abstract] The artificial earth satellite "Kosmos-921" was launched in the Soviet Union on 24 June 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 98 minutes;
- apogee, 711 kilometers;
- perigee, 644 kilometers;
- orbital inclination, 76 degrees. [5]

#### PROGRESS OF "SALYUT-5" REPORTED

Moscow PRAVDA in Russian 23 Jun 77 p 3

[TASS Report: "In Space Orbit"]

[Excerpt] Flight Control Center, 22 June. The directed controlled flight in near-earth space of the "Salyut-5" orbital research station has been successfully continuing for a year. By 1200 hours Moscow time the station had completed 5,867 orbits around the earth.

Research was carried out on the station during the period of the two crews, consisting of Comrades B. V. Volynov and V. M. Zholobov, V. V. Gorbato and Yu. N. Glazkov during automatically controlled flight. A broad program of scientific research and experimentation has been carried out.

With the aid of photography equipment, broad areas of the Soviet Union and the world ocean were photographed in the interests of various branches of the national economy. Several thousand frames of color, spectrozonal and black-and-white photographs have been received.

Studies of the physical characteristics of the earth's atmosphere and near-earth space have been made. Astrophysical studies of the sun, space surrounding the sun, the moon, and other celestial bodies have been carried out using an infrared telescope-spectrometer.

A new direction in research on the "Salyut-5" station was represented by the experiments in the study of the occurrence of various physical processes and the undertaking of technological operations under weightlessness conditions. Complex medical and biological experiments with living organisms and various plants were also carried out on the station.

During the course of the flight of the "Salyut-5," which began on 22 June 1977, the on-board systems and scientific equipment have been functioning normally. The atmospheric content, temperature and pressure are within the assigned limits. The flight of the "Salyut-5" continues. [5]

# TASS ANNOUNCES LAUNCHING OF "KOSMOS-920"

Moscow PRAVDA in Russian 23 Jun 77 p 3

[TASS Report: "'Kosmos-920'"]

[Abstract] The artificial earth satellite "Kosmos-920" was launched in the Soviet Union on 22 June 1977. The satellite was inserted into an orbit with the following parameters:

- initial period, 89.7 minutes;
- apogee, 364 kilometers;
- perigee, 180 kilometers;
- orbital inclination, 65 degrees. [5]

## REPORT ON "SNEG-3" FROM COSMODROME

Moscow PRAVDA in Russian 18 Jun 77 p 6

[Article by V. Gubarov, "'Sneg-3' Over the Planet"]

[Summary] A Soviet rocket recently put the French satellite "Sneg-3" into space. It is hoped that the new satellite will enrich astronomy with new data and that French and Soviet scientists will collaborate as successfully and with such harmony as during preparations for the launching when they begin the processing and analysis of the collected data. Its gamma telescope will seek mysterious sources of gamma radiation among the stars: black holes, quasars, pulsars and supernovae. The gamma quanta generated in these worlds permeate space without changing their properties. For them the universe is transparent and they carry information on processes in distant worlds. The interception and study of gamma quanta will help in understanding how stars are born and die, how galaxies are formed and perish. Soviet-French cooperation in space, which has continued now for more than ten years, takes in different fields of science. These areas include space, meteorology, communications, biology and medicine. The Soviet lunokhods carried French laser reflectors. Instrumentation fabricated at Toulouse and at the Meudon Observatory have been carried aboard the "Mars" interplanetary stations and on the "Prognoz" satellites. French rockets launched on the shores of the Bay of Biscay carried in their nosecones Soviet instruments for investigating the composition of the upper atmosphere. Soviet meteorological rockets launched on Kheys Island have carried French instrumentation aloft. Regardless of where the experiments are carried out, in Arkhangel'skaya Oblast or on Kerguelen, in French Guiana or at the Soviet cosmodrome, in the joint work it is always possible to trace the most timely scientific directions and both sides are sharing their attainments with one another.

[110]

### Abstracts of Scientific Articles

#### ACCURACY IN DETERMINING COORDINATES OF STATIONS BY ORBITAL METHOD

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 5, 1977 pp 17-22

[Article by V. V. Boykov, "Analysis of Accuracy in Determining the Coordinates of Stations by the Orbital Method"]

[Abstract] The appearance of artificial earth satellites has led to the development and rapid introduction of different space geodesy methods. The most importance of these are the geometric and orbital methods. In the early stage of use of satellites in geodesy it was the geometrical method which was used most. Accordingly, a theory of evaluation of the accuracy of geodetic constructions was developed. However, the difficulties in implementing the geometric method (need for synchronizing observations from several stations) and the developing of the theory of motion of satellites led to the extensive use of the orbital method. The theory of the orbital method has now been developed quite well. However, an a priori evaluation of accuracy is made for the most part by numerical modeling methods which make it possible to obtain evaluations for specific series of observations, but this does not fully characterize the quality of the construction as a whole. This makes difficult the formulation of the fundamental principles of optimum planning of geodetic networks by the orbital method. Therefore, in this stage of development of space geodesy a timely problem is the formulation of a theory for the evaluation of accuracy in analytical form for the orbital method. Some aspects of this theory are examined in this article. [122]

#### REFINEMENT OF ORBITS OF ARTIFICIAL EARTH SATELLITES

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 4, 1977 pp 21-25

[Article by Yu. V. Surnin, V. A. Ashcheulov, Yu. V. Dement'yev, N. N. Yegorov, S. V. Kuzhelev and A. M. Tokarev, "Program for Refining the Orbits of Geodetic Artificial Earth Satellites Using the Results of Optical Observations"]

[Abstract] The authors describe the theoretical principles, technical specifications and possibilities of a computation program designed for the differential improvement of a Keplerian system of orbital elements of artificial earth satellites on the basis of photographic and laser observations from ground control stations. The program can be employed for predicting the motion of satellites with an accuracy of about  $10^{-7}$  on short orbital arcs in several revolutions. The basis for constructing an orbit is the numerical method for the integration of a system of Newton-Euler equations in which there is exclusion of the peculiarities for circular, equatorial and polar orbits. The program takes into account perturbations from the aspherical structure of the earth, atmospheric drag, light pressure and attraction of the moon and sun. The program was formulated in the ALGOL-60 language and has been applied on two electronic computers: M-222 ("TA-1M" translator) and Odra-1204 ("ALGOL-1204-D" translator). A full-page block diagram of the program is given and serves as a basis for the textual discussion.

[131]

#### METHOD FOR COMPUTING $N(h)$ PROFILES

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR, SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 2, 1977 pp 40-46

[Article by Ya. Akyyev, M. Berkeliyev and A. Khanberdiyev, Physical-Technical Institute Turkmen Academy of Sciences, "Computation of  $N(h)$  Profiles Taking into Account the X-th Component in the E and F Regions"]

[Abstract]  $N(h)$  profiles were computed using ionograms for Ashkhabad station with a clearly observable trace of the x-th component of the E and F regions. Profile computations were made for three variants: for the ordinary component; taking into account the extraordinary component of the F region; taking into account the extraordinary component of the E and F regions. It is shown that the joint processing of both magneto-ionic components introduces a significant correction to the form of the  $N(h)$  profile for the winter and summer seasons, especially for the latter. It is possible to trace changes in the parameters of interlayer ionization depressions. The determined  $N(h)$  profiles for the altitudes of the lower part of the ionospheric E region are very close to the real distribution of electron concentration. Some improvements have been introduced into the program for the input of data into an electronic computer, with the use of which the number of considered points is reduced with respect to frequency by a factor of 8-10 and with respect to virtual height by a factor of 4-5.

[125]

## VI. MISCELLANEOUS

### News

#### BRIEF REVIEW OF LAST FORTY YEARS OF ARCTIC RESEARCH

Moscow IZVESTIYA in Russian 14 Jun 77 p 5

[Article by Ye. Tolstikov, "The Arctic Without White Spots"]

[Summary] On 21 May of this year the Soviet scientific community celebrated the fortieth anniversary of establishing of the first Arctic drifting station "SP-1." This was followed by many others, and now the drifting stations "SP-22" and "SP-23" are operating. The results of the scientific investigations of the drifting stations and the "Sever" expeditions are enormous. Specialists have studied synoptic processes over the Arctic and have written scientific papers on the climate of the region of the drifting ice. There has been a radical change in our ideas concerning the relief of the Arctic basin. As a result of scientific investigations in the Central Arctic it has been possible to clarify the circulation of waters in the surface layers in the Arctic basin. It has been established that there are two general currents: the broad transarctic current from Bering Strait to Fram Strait between Greenland and Spitzbergen and a broad anticyclonic circulation of waters in the Amerasian subbasin. There have been many discoveries in the fields of geophysics, hydrobiology and microbiology. Thus, the Arctic Ocean has been studied better in some parts than in most regions of the world ocean. But a qualitatively new stage in the investigation of the polar basin began with the POLEKS experiment, directed to the formulation of a theory of climatic change and creation of long-range weather forecasts and prediction of ice conditions. The principal tasks of the POLEKS program applicable to the polar region are related to determination of the contribution of the ocean to the energy balance of the north polar region, study of energy exchange in the ocean-atmosphere system and the year-to-year dynamics of the circulation of waters in the Arctic basin, water exchange between the Arctic Ocean and the Pacific and Atlantic Oceans, interaction between the Arctic atmosphere and the temperate latitudes. These matters were investigated to the fullest degree during April-August 1976 in the national "POLEKS-SEVER-76" experiment with the participation of ten scientific institutes



of the Hydrometeorological Service, ten ships, two IL-18 aircraft and about 90 ground aerological stations. Important scientific results were obtained making it possible to refine the mechanisms of large-scale interaction between the atmosphere and ocean for the purposes of improving numerical weather forecasting models. Arctic research will be continued for the purpose of further development of weather forecasting methods, continuing study of the polar regions of the world ocean, preservation of the environment, implementation of measures for lengthening the navigation season on the Northern Sea Route. In the continuing POLEKS program the principal objectives of collection of hydrometeorological information will be implemented using drifting stations, scientific research ships, surface aerometeorological stations. Plans call for the joint study of energy exchange between the ocean and atmosphere in the presence of an ice cover in the North European Basin using artificial earth satellites and drifting buoys set out by Norwegian researchers.

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